

*Business Systems Planning (BSP) and Business Information Control Study (BICS) are two information system planning study methodologies that specifically employ enterprise analysis techniques in the course of their analyses. Underlying the BSP and BICS analyses are the data management problems that result from systems design approaches that optimize the management of technology at the expense of managing the data. In comparing BSP and BICS, five similarities and five differences are selected for discussion, and, finally, the strengths and weaknesses of each methodology are noted. The choice between using one or the other methodology is strongly influenced by the immediate intent of the study sponsor, tempered by the limiting factors currently surrounding the BICS methodology.*

## **Business Systems Planning and Business Information Control Study: A comparison**

**by J. A. Zachman**

Business Systems Planning (BSP)<sup>1</sup> and Business Information Control Study (BICS)<sup>2</sup> are representative of enterprise analysis tools that are growing in importance and are likely to become mandatory for any business that continues to grow and evolve. BSP and BICS have common roots in their attempts to describe a business at the enterprise level in terms of its information characteristics. As our understanding of information systems evolves, it is becoming clear that some enterprise-level description of a business unit is required for several reasons.

First, there is a requirement to select information system resource investment opportunities that hold the greatest relative potential benefit for the business unit as a whole. Therefore, some comprehensive identification of enterprise-wide opportunities for employing information technologies must be made in order to establish a context within which the relative assessment can be made.

Second, because of the necessity to produce short-term results in any given enterprise, there is a requirement to design and build large numbers of small systems. To avoid high costs of redesign for integration purposes, the small systems should be built in such a

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fashion that they are compatible and consistent at the outset, or so that they will fit together as they are completed. Therefore, an enterprise-level architecture is required to constrain the design and development activity such that the relationships and dependencies can be identified and protected.

Third, because of resource constraints and/or technology limitations, substantial gaps usually exist between what is desired, what is feasible, and what is implemented. Because of this situation, the management of a business is continually in a position of having to trade off between short-term investments and long-term investments. The short-term investments tend to be results-oriented, cost-effective, quick and dirty, cheap, practical, etc. The long-term investments tend to be quality-oriented, flexible, long-lived, best, optimum, etc. Therefore, an enterprise-level architecture is required to serve as a context within which to make the trade-off decisions between the long-term and short-term options. Furthermore, the architecture is required as a base line to manage the change activity which is inevitable as a result of selecting shorter-term options rather than longer-term options, as well as the change activity resulting from the restructuring of the business which can be expected over time.

These issues are arising because the technology increasingly supports enterprise-wide, top-down systems in design, but the practicalities of resource limitations, development project size manageability, and the requirement to produce short-term results make the bottom-up, piece-by-piece approach to implementations mandatory. Therefore, enterprise-wide "architectures," or structures, through BSP, BICS, or some other methodology can be expected to be increasingly prevalent as the technology continues to evolve.

Although many popular information systems planning methodologies, design approaches, and various tools and techniques do not preclude or are not inconsistent with enterprise-level analysis, few of them explicitly address or attempt to define enterprise architectures. Some examples of such popular offerings include

- *Planning Methodologies*: Stage Assessment,<sup>3</sup> Critical Success Factors,<sup>4</sup> Strategy Set Transformation,<sup>5</sup> etc.
- *Design Approaches*: Structured Analysis,<sup>6</sup> Entity-Relationship Approach,<sup>7</sup> etc.
- *Tools and Techniques*: Problem Statement Language/Problem Statement Analyzer (PSL/PSA),<sup>8</sup> Prototype Development Methodology,<sup>9</sup> Structured Analysis and Design Technique,<sup>10</sup> etc.

From an historical perspective, BSP and BICS likely will be looked back on as primitive attempts to take an explicit, enterprise-level architectural approach to information systems.

BSP is a study methodology that has been offered as a market support program by IBM since 1970. It was developed as a result of some internal IBM experience acquired by the IBM Corporate Information Systems (I/S) Architecture group when I/S was still centralized during the late 1960s.

BICS is also a study methodology currently under development at IBM. Although it is not available for general use, it is evolving from some initial experience acquired during the mid-1970s at the IBM Santa Teresa Laboratory. It draws heavily upon a theory called Business Information Analysis and Integration Technique (BIAIT<sup>TM</sup>),<sup>11,12</sup> as well as upon BSP.

The BIAIT theory proposes that the complete information-handling characteristics of a business can be predefined given an understanding of seven binary variables relating to how the business handles its orders. For example, one variable is, "Does the business bill the customer for his order?" If so, then the information-handling characteristics include some form of credit checking, bill preparation, accounts receivable management, etc. If the business does not bill for the order, then it receives cash and in this case information-handling characteristics are not implied. Similarly, the other six variables reveal additional information-handling characteristics about the business. When this analysis is applied to each type of order the business receives, the result is an identification of all the information-handling characteristics of the business. Since BICS has been successfully used in more than six widely diverse internal IBM business units, there is some good empirical evidence that the BIAIT theory can be employed effectively in enterprise analysis.

BSP and BICS are both study methodologies, and, therefore, it is easy to compare them, identifying their major similarities as well as their major differences.

### **BSP and BICS similarities**

Five similarities have been selected in discussing the two methodologies. These are labeled A through E.

In Similarity A, the objectives of both BSP and BICS are to support Information Systems planning at the strategy level. The analysis that is performed establishes the utility of taking architectural approaches to information systems, the implications of managing (or not managing) the data of the business, and the areas of the business holding the greatest relative potential for investing information systems resources. The analyses do not result in design specifications or even cost-benefit determinations. In order to get to that level of detail, additional analysis must be performed over and above that specified for the BSP or BICS studies. Therefore, to reiterate, the BSP

**study  
objectives**

and BICS analyses are planning-oriented, not design- or implementation-oriented, and they support the strategy level of I/S planning. The kinds of questions they seek to answer are "What design strategy should I/S employ?" "What should the role of I/S be?" "What areas of the business hold the most potential for investing current I/S resources?" "Which I/S resources should be optimized at the expense of which others?"

**analytical  
approach**

In Similarity B, the analytical approach employed by both BSP and BICS is "top down." The implications of the words "top down" are multiple and varied, and all apply to these analyses. For instance:

- Top down implies scope—that is, looking at the business as a whole as opposed to looking at pieces or subparts of it.
- Top down implies level of detail—that is, looking at the highest level of summarization and then decomposing hierarchically to lower levels of detail as required.
- Top down implies perspective—that is, the perspective of the highest levels of management as opposed to the operational levels of management.

In all of these senses, both BSP and BICS are top-down analyses.

**orientation**

For Similarity C the analyses are data-oriented. Analyses that are performed for the purpose of defining requirements or of defining design specifications tend to focus on function, information, or data. The analyses that are functionally oriented identify and define the function of the business that requires automation, specify what the system has to *do*, and secondarily define the data required or the information that is a by-product. In the context of "input-process-output," the primary focus is on the "process."

Information-oriented analyses identify and define the information required to make a decision, or the form or report that is required, and then secondarily define the input data and processing required to produce the desired information. In the context of "input-process-output," the primary focus is on the "output."

Data-oriented analyses identify and define the data that is required or being used in the business and secondarily define the processes required to acquire the data and the information that can be derived from the data. In the context of "input-process-output," the primary focus is on the "input."

Although neither BSP nor BICS is employed at a level of detail specific enough to result in requirements definition or design specification, they are both data-oriented in nature. That is, they focus primarily on the data required to manage the business (input) and secondarily on the function (process) or information (output). The reasons for the focus on the data, or "input," side of "input-process-output" is

that they are both seeking to address the data problems that exist in applications portfolios where there has been a prevalence of functional (process) orientation and/or information (output) orientation at the expense of the data (input). Furthermore, BSP and BICS focus on the data (input) in lieu of information (output) because they are both seeking to establish architectures, which favor stability. The information (output) that the business demands is variable and unstable over time<sup>13</sup> and is not desirable for use in an architectural sense except that whatever architecture is developed must be able to support the information requirements (output) on demand.

BSP does define function (processes) at a fairly high level of aggregation. However, the processes are defined primarily as a vehicle for identifying the data, gaining some assurance that all the data has been identified, and proving that the same data is being used by multiple processes (thus laying a foundation for determining whether a data problem exists in the application portfolio as a result of an historical focus on function or information).

It must be pointed out that even though BSP and BICS tend to focus on the data, the fact that they attempt to produce an architectural statement suggests that they must ultimately provide for a balance between data (input) and function (process) in support of the highly variable information (output) requirements of the business. The BSP architecture product of the study does portray both data and function. The function element of the BICS architecture is currently under development.

In Similarity D, both analyses result in two analytical products, including

**analytical  
products**

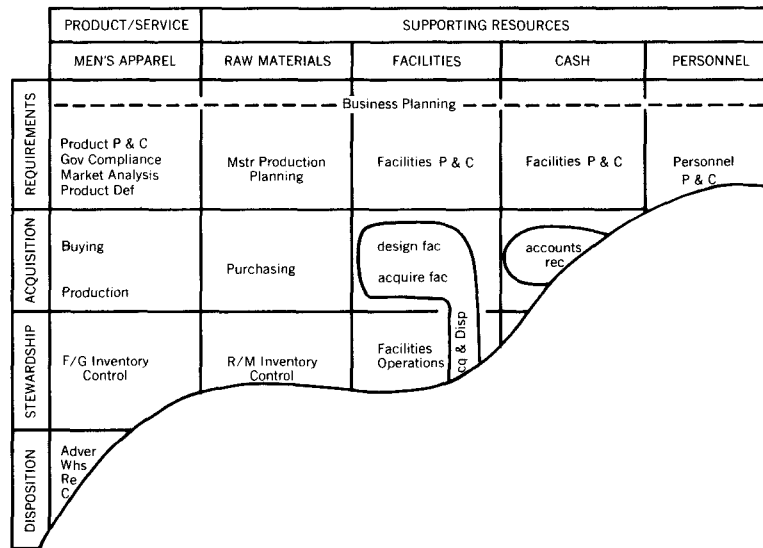
1. A structure, or architecture, in information terms, which describes the business unit under study.
2. An identification of management's priorities as related to the structure developed.

In Similarity E, both analyses employ management interviewing techniques as the source of data for determining the relative priorities of I/S investment opportunities. Furthermore, the questions asked are basically the same although different in approach. BICS asks, "What are your critical success factors?"<sup>14</sup> which is a very practical way to get at "What are your objectives?" BSP also asks, "What are your objectives?" but finds much more substantive analytical data from the inverse, "What are your problems?" The problem and objective questions are the same in that one is the inverse of the other. That is, a problem is not a problem unless there is an objective it is keeping you from meeting.

**data gathering  
technique**

Another shade of difference lies in the fact that BICS uses a group interview technique, whereas BSP uses the individual interview tech-

Figure 1 Defining BSP processes, an example



nique and then analytically integrates the data. The intent and data gathered from the management interviews are, however, basically the same.

### BSP and BICS differences

Five differences between the two methodologies were selected for comparison.

#### entrance into the analysis

Difference A is a result of BSP and BICS entering into the business analysis through different avenues. BSP enters into the analysis by defining the products (or services, as the case may be) of the business unit. Next, the resources required to produce the products are identified. Then, by using the product and/or resource life cycle, the processes (or functions) that have to be performed to manage the products and resources over their life cycles are identified. From the processes, the data required to manage the processes is defined. Then the relationship between the processes and the data is documented and constitutes a structure (or architecture) that represents the "functional specifications" and the "material (data) specifications" of the information "product" required to support the business unit. Figure 1 is an example of how BSP initiates the analysis by identifying the products and resources of the business and how it then employs the life cycle concept<sup>15</sup> for identifying the processes. This analysis is used ultimately to develop the process/data class structure which is described in Difference B.

Figure 2 BICS analysis of order types using BIAIT, an example<sup>2</sup>

| BUSINESS<br>VARIABLES                   | ORDERS |    | MACHINES | MES | MES | EQUIPMENT | ... |
|-----------------------------------------|--------|----|----------|-----|-----|-----------|-----|
|                                         |        |    |          |     |     |           |     |
| BILL<br>CASH                            | 1      | X  | X        | X   | X   | X         |     |
| FUTURE DELIVERY<br>IMMEDIATE DELIVERY   | 2      | X  | X        | X   | X   | X         |     |
| CUSTOMER PROFILE<br>NO CUSTOMER PROFILE | 4      | X  | X        | X   | X   | X         |     |
| PRICE NEGOTIATION<br>FIXED PRICE        | 8      | X  | X        | X   | X   | X         |     |
| RENT<br>SELL                            | 16     | X  | X        | X   | X   | X         |     |
| TRACK<br>NO TRACK                       | 32     | X  | X        | X   | X   | X         |     |
| MADE TO ORDER<br>PROVIDE FROM STOCK     | 64     | X  | X        | X   | X   | X         |     |
| TOTAL                                   |        | 99 | 99       | 35  | 67  |           |     |

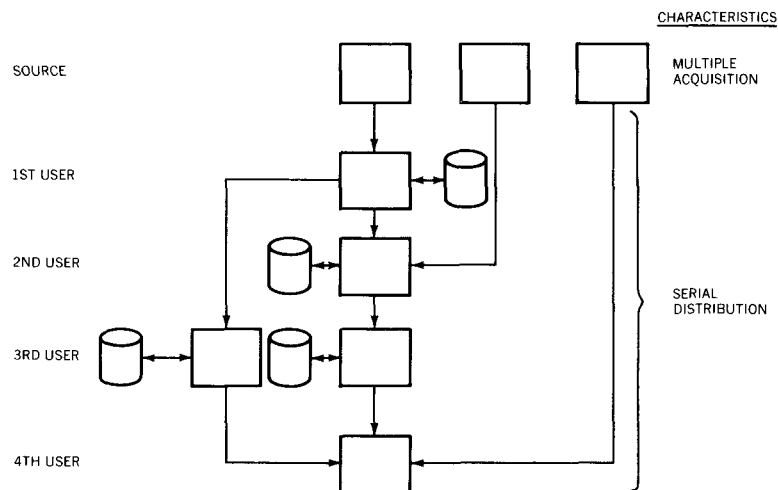
In contrast, BICS enters into the analysis through the orders the business receives. After all of the order types have been identified, each order type is subject to the BIAIT analysis which, through the seven binary variables as in Figure 2, selects out of a predefined set of data categories those categories that are required to support the orders the business receives. Added to these categories of data are data categories required to support the "common business functions," which are those functions that are independent of the kinds of orders received, or those functions that are common to every business unit. (An example of a common business function might be "pay employees.") The resultant subset of data categories applicable to the given business unit are related to the organization structure of the business, and this serves as the structure (or architecture) that BICS uses for further analysis. Figure 2 is an example of a BIAIT analysis of the orders of a business. (Note that two types of orders the business receives in this case have identical information-handling characteristics.) This analysis is then used to extract the appropriate data classes out of the total list of all possible data classes.

BSP, then, enters into its analysis through the products/resources of the business, whereas BICS enters in through the orders of the business.

In Difference B, the structures that BSP and BICS develop are decidedly different, although they both use a matrix format to display the relationships that constitute the structure.

**structures  
developed**

Figure 3 Treatment of data under "technology-managed" systems design<sup>4,16</sup>



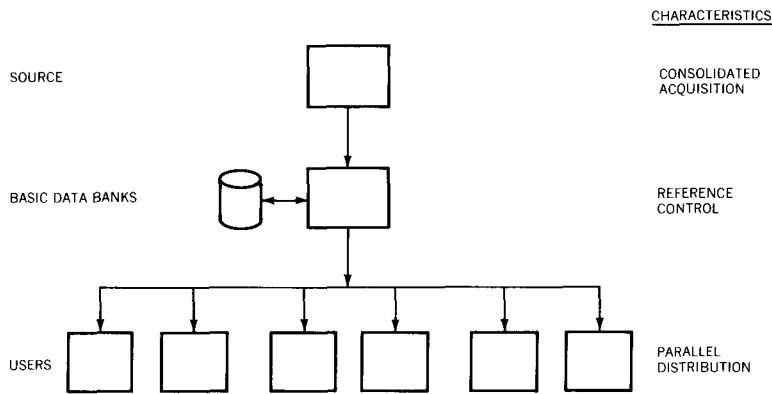
BSP focuses primarily on the process versus data relationship as noted in Difference A. Although there are several other relationships that are developed in the course of the analysis, the others support intermediate and/or secondary conclusions. The process/data relationship is chosen as the primary one because BSP hypothesizes at the outset that the business unit under study has a data problem, and it then sets out to prove (or disprove) the hypothesis. A data problem results when the system design objectives are to optimize the technology resources at the expense of the data—that is, build applications quickly and cheaply in a cost-effective fashion as far as technology is concerned (that is, hardware/software and people), thereby treating the data as a secondary issue. The development methodology in this environment has the following steps:

1. Identify the functional (or information output) requirements.
2. Design the systems functions (or information output).
3. Figure out what data is required and identify the quickest, cheapest source of the data.
4. Extract the data from an existing file and reproduce it for the new system, recreate it at the source, or use a secondary source.

The repetitive use of this approach results in multiple sourcing and serial distribution of the data<sup>4,16</sup> as in Figure 3. The problem that evolves as applications are added to the applications portfolio is loss of control of the data because the same data begins to reside in multiple systems, is inconsistent, unreconcilable, unavailable, and frustrating to management. If the problem is bad enough, management potentially loses visibility into the data and, therefore, into the operations and resource utilization of the business, and the business develops a control problem.



Figure 4 Treatment of data under "data-managed" systems design<sup>4,16</sup>



If, in contrast, the systems design objective is to optimize the management of the data at the expense of the technology, the steps in the development methodology would be

1. Identify a single source for every kind of data in the business.
2. Establish a reference control for managing the data.
3. Design the functions required to acquire the data at its source and control the integrity of the data at the source.
4. Design the information output systems on demand using the reference control facility.

This approach results in single-source, parallel distribution of the data<sup>4,16</sup> as represented in Figure 4. The potential problem in this environment is extravagant use of the technology, designing and managing data for which there is no requirement.

Because only around half of the large businesses in the United States in 1979 had evolved to late Stage III or early Stage IV with regard to the Stage Hypothesis,<sup>3</sup> their focus was on managing the technology as opposed to managing the data. The former problem of multiple-source, serial distribution of the data is far more prevalent than the latter problem potentially associated with the data-managed environment.

Therefore, BSP uses the process/data relationship to expose the data problem because by so doing, it can be shown that a single process "creates" some kind of data and that other processes "use" the same data. Hence, a single source with parallel distribution of data naturally exists within the business under study. Figure 5 is an example of a process versus data class matrix in which the "create" points are differentiated from the "use" points. By contrasting the current data processing systems, they can be shown to have multiple

[illegible]

Furthermore, BSP chooses the process/data relationship because of its stability over time and because it serves to highlight the long-term versus short-term trade-off decisions that must be made regarding information systems investments. The stability derives from the fact that substantial effort is invested to extract the variable aspect from both the processes and the data as they are represented in the structure. Stability is found in the "what," whereas variability is found in the "how." In the case of processes, "what processes (functions) have to be performed" is stable over time, whereas "how

the processes are performed" varies considerably. By the same token, in the case of data, "what things the business needs to know about" is fairly stable, but "how the data about the things is used" varies considerably. Therefore, the process/data relationship can be stated in such a way that it is stable by focusing on the "what" rather than the "how."

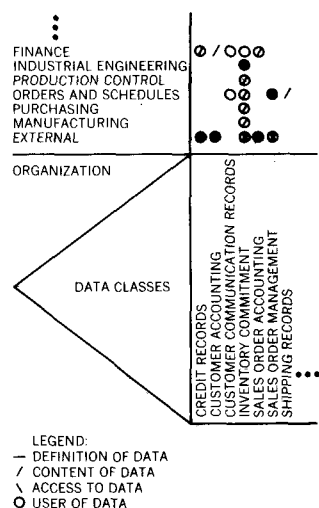
With regard to the long-term versus short-term trade-off, the long-term option is represented by the data rows of the matrix, whereas the short-term option is represented by the process columns of the matrix. The long-term strategy is to take a data-driven approach to information systems design, identifying the single data source and providing data design for multiple usages of the same data, some of which may not materialize until some time later. The short-term strategy is to take a process-driven approach, building application systems to support processes, serially supplying data (that is, ignoring the data problem), which is the more prevalent approach being used by the data processing community at this stage of its evolution.

In summary, BSP chooses the process/data class structure because it is trying to identify the data problem, it is seeking to develop a stable foundation for architectural use, and last, it is attempting to highlight the long-term, short-term trade-off decisions that must be made by the management of the business.

In contrast, BICS focuses on the data/organization relationship (see Figure 6) primarily because its thrust is toward quick implementations. BICS does not seek to use the data/organization structure in an architectural sense. That is, it does not use the structure to identify system dependencies, interfaces, or boundaries, nor to identify the long-term or short-term trade-off alternatives, nor to use it in the future as a foundation upon which to develop hardware, software, or geographic (distribution) architectures. Neither is BICS attempting to use the structure explicitly to expose the data problem, that is, the multiple-source, serial distribution of data versus single-source, parallel distribution.

BICS is, however, using the data/organization structure as an analytical tool to identify a specific data problem and suggest a specific data solution. Therefore, it examines organizational responsibilities with regard to the data in order to identify conflicts in authority which cause data control problems. Further, when superimposing some business problem analysis on the data/organization structure, it seeks to identify a specific organization in which to localize a data problem solution. As an implementation, BICS suggests finding the best available copy of some specific data, wherever it can be found, in whatever state of integrity it exists, dumping that data into a relational data base management system, establishing administrative controls at the point it enters the relational system, and making it available to users. BICS does not suggest going to the source for

Figure 6 BICS organization versus data class matrix, an example<sup>2</sup>



control or dealing with the transaction processing apparatus at all. It, in effect, treats the acquisition of the data by the relational system as the single source.

BICS can take this short-term (quick and cheap) approach to implementation, without addressing the transaction processing or data source issue, and still be considered a data-oriented, longer-term perspective on several counts. First, since it does not attempt to deal with transaction processing, the relational data base environment is an appropriate implementation. Second, the relational data base environment is very forgiving when unforeseen data relationships require support as new data views are identified by management. Third, because BICS is employing predefined data classes at the enterprise level (see Difference C), it is reasonable to predict that at some point in the future it will have predefined the data "elements" and predefined the reasonably anticipated data relationships. Therefore, BICS will have simplified resolving the enterprise-level data problem through predesign.

Observe that BICS does not ignore the longer-term issues, that is, controlling the integrity of the data at its source and establishing an architecture for managing the data resources. The study strategy is to establish an environment conducive to addressing the longer-term issues by quickly relieving some current management frustration with the data and introducing tools (Data Base Management Systems, Dictionary, Data Administration, etc.) and the data-oriented mentality which are foundational for the long-term solution. Subsequently, as some of the frustration with the data processing organization of a business is alleviated, and as skills develop and value is perceived with regard to managing the data, the environment is prepared for addressing the transaction processing and data source control issues.

Time favors this study strategy. Not only does the price-performance trend of the technology make the longer-term approaches to solving the data problem more feasible and desirable, but also, development work continues on the BICS methodology. Work is now being done on BICS to incorporate processes (functions) into the data/organization structure. This work will allow predefined processes to be selected from a generalized model on the basis of the BIAIT variables just as the data classes are currently selected. With a process/data/organization "model," it would be possible to raise the longer-term data issues during the initial study even though the BICS strategy may continue to emphasize the shorter-term implementation options.

At this point, the observation must be made that BSP does not ignore the requirement for quick, short-term implementations, just as BICS does not ignore the longer-term, data management issues. A BSP study could well recommend short-term implementations or classic

functional (process) or informational (output) systems (see Similarity C) either because a study team did not have a clear understanding of BSP's analytical strategy or because the business was not yet ready to deal with the data problem. As a matter of fact, since the preponderance of businesses in the United States are still in Stage I, II, or III,<sup>3</sup> BSP studies typically have been done in businesses that were not ready to explicitly address the long-term, data issues.

Furthermore, there is nothing about BSP that precludes recommending a BICS-like implementation. In this regard, BSP recommends developing a data class/organization relationship as a desirable option subsequent to the initial BSP analysis and precisely aimed at getting to a quick fix. However, the BSP analysis clearly is designed to confront management with the long-term issue, "Do you want to change your I/S strategy from optimizing the technology to optimizing the data?" and, secondarily, somewhat in answer to this question, to address the short-term implementation options.

To summarize this point concerning the differences between the structures developed by BSP and BICS, we can say the time constraints imposed on enterprise analysis methodologies force them to adopt expedient strategies. BSP chooses to identify the long-term data issue up front and then develop an implementation to relieve current management frustrations. This procedure leads to the use of the process/data class structure during the BSP study. BICS chooses to relieve short-term frustrations up front and deal with the long-term data problem later. This procedure leads to using the data/organization structure during the BICS study. Both methodologies would develop both structures and present both the long- and short-term options if time during the study was available to do so.

Difference C is a result of BSP and BICS using different approaches to data classification. Because BSP and BICS are basically planning-oriented methodologies employing top-down approaches to analysis, they both deal with classes of data rather than data entities and attributes (or "data elements") in a specific sense. Such a level of detail is not necessary for planning, nor is there sufficient time during a study to collect and manipulate the detail that is necessary for design level analysis. Although BSP and BICS classify the data very differently, they both use the same two criteria for classification, namely (1) uniqueness of data by class and (2) uniqueness of source of data by class.

Uniqueness of data by class means that the classification scheme is structured such that no specific "data element" can be assigned to more than one data class at one time. That is, all the specific data elements in a given data class are unique to the class, or there is no redundancy of data between classes. This classification criterion must be met if data redundancy and consistency are to be controlled as a resultant information systems strategy.

#### **data classification**

Both BSP and BICS attempt to meet this criterion by taking entity-oriented approaches to defining data classes. If every data element is expressed as an attribute of an entity, there is good assurance that all the attributes of an entity are unique to that entity, and, therefore, the "data elements" can be classified uniquely by entity. For example, all the attributes of an entity "Employee" are unique to employee and are not attributes of "Part," "Customer," "Vendor," etc. (There may be generic redundancy but no specific redundancy; for example, "address" is generically attributable to both customer and vendor, but specifically attributable to one or the other.)

Additionally, BSP and BICS deal with classes of entities that are high-level, with aggregations of entities being referred to in data administration vernacular as Business Subject Entities. That level of detail and that designation are appropriate and necessary because of the planning orientation of the studies and the limited time available for analysis.

The difference between the two methodologies (as far as uniqueness of data by class is concerned) lies in the specification of the Business Subject Entities. BICS specifies 12 Business Subject Entities (called Data Inventories) into which all of the entities of the business must be classified. BSP allows the identification of however many Business Subject Entities (called Business Entities) the study team deems necessary to describe the business in terms of the data it must manage. Both approaches, however, are attempting to get at a classification scheme that provides for nonredundancy between classes, or uniqueness of data by class.

The second criterion, uniqueness of source of data by class, is intended to group the attributes of the Business Subject Entities such that all the attributes in the group come from the same source or enter into the business "system" at the same point. This criterion is a subclassification of the entity attributes of the initial classification of Business Subject Entity. It is necessary if the integrity of the data is to be controlled as a resultant information systems strategy because data integrity must be controlled at the point where the data enters the business.

BICS specifies four subgroupings of attributes, namely plan-value attributes, plan-descriptive attributes, actual-value attributes, and actual-descriptive attributes. Then, within each of the four groupings of attributes, a further classification is specified which is unique by source based upon empirical observation and experience acquired employing the BICS model. There may be one or more such subclasses for each grouping. The BICS data classification scheme is illustrated in Figure 7.

In contrast, BSP attempts to satisfy the second criterion, uniqueness of source of attributes by class, by suggesting that there are four

Figure 7 BICS data classification structure

TAXONOMY

| BUSINESS SUBJECT ENTITY |             |         |             |
|-------------------------|-------------|---------|-------------|
| PLAN                    |             | ACTUAL  |             |
| VALUE                   | DESCRIPTIVE | VALUE   | DESCRIPTIVE |
| a, b .....              | d .....     | h ..... | ..... n     |

BICS TERMS

DATA INVENTORY  
(12 SPECIFIED)

DATA GROUPS

DATA CLASSES  
(UNIQUE BY SOURCE)

Figure 8 BSP data classification structure

TAXONOMY

| BUSINESS SUBJECT ENTITY |             |           |             |
|-------------------------|-------------|-----------|-------------|
| PLAN                    | STATISTICAL | INVENTORY | TRANSACTION |
| a, b .....              | d .....     | h .....   | ..... n     |

BSP TERMS

BUSINESS ENTITY  
(OPEN ENDED)

DATA TYPE

DATA CLASSES  
(UNIQUE BY SOURCE)

types of attributes of entities: planning attributes, statistical/summary attributes, inventory attributes, and transactions. The study team examines each of the processes that have been identified and defines classes of data within the attribute types that are either "used" or "created" by each process. In this fashion, the process/data relationship illustrated in Figure 5 is created. There may be none, one, or more data classes by type of attribute. The BSP data classification structure is pictured in Figure 8.

The question is, "Which of the two classification schemes is the best?" Actually, any classification scheme that meets the two criteria on uniqueness is adequate. It is highly likely that at the lowest level of detail, the data classes of BSP and BICS are very similar even though they were arrived at very differently. The BICS approach is probably a little bit cleaner because it has had the benefit of about five years' more experience in data-oriented research.

In the current BSP documentation, the material on data classes was conceived and documented around 1975, long before the entity-relationship-attribute<sup>7</sup> material became generally available and the criteria for classifying the data could be clearly articulated. However, even at that time, it was felt that there were some general

Table 1 BSP data class types compared to BICS data groups

| <i>BSP</i>            |                            | <i>BICS</i>                    |
|-----------------------|----------------------------|--------------------------------|
| Plans/models          | is roughly equivalent to:  | Plan-value<br>Plan-descriptive |
| Statistical/summaries | is roughly equivalent to:  | Actual-value                   |
| Inventory             | is roughly equivalent to:  | Actual-descriptive             |
| Transactions          | <i>have no equivalent.</i> |                                |

categories or types of data within the broader business entity classification. The BSP data class types can be generally compared to the BICS data groups as in Table 1.

With regard to the transaction data type of BSP, which has no direct equivalent in BICS, the BSP thinking was that transaction data had to be accounted for in the classification scheme. What was not clear was what was meant by "transaction."

If "transaction" refers to a change in the state of a Business Subject Entity, then it is equivalent to or included as part of the Actual-Descriptive data group of BICS. But if "transaction" refers to a document that records a relationship between two Business Subject Entities, one of which is changed in state (or status) and the other of which is the agent (or recipient) of the change, then the business treats that document, or "transaction," usually called some kind of "order," as a resource in its own right.<sup>15</sup> The business plans for it, inventories it, keeps statistical data about it, in short, treats it like another business entity. An "order" has data attributes in its own right, including serial number, date, status, etc., over and above the attributes of the other two Business Subject Entities whose relationship the order records. Therefore, if "transaction" refers to "order," it is not a type of data but another Business Subject Entity and should appear on the Business Entity axis and not the Data Type axis of the Business Entity/Data Type Matrix used by BSP. (See Figure 9.)

The confusion arises concerning what is meant by transaction in the BSP classification scheme because the examples in the BSP documentation use transactions interchangeably to mean change of status in some instances and orders in others. As a matter of fact, many of the examples of the other data class types in the BSP documentation (Figure 9) are not pure with regard to the classification criteria primarily because the criteria had not been clearly articulated at the time the document was published.



Figure 9 BSP data classification, an example<sup>1</sup>

| BUSINESS ENTITIES<br>DATA CLASS TYPES | Product                                   | Customer                        | Facilities                               | Material                                     | Vend |
|---------------------------------------|-------------------------------------------|---------------------------------|------------------------------------------|----------------------------------------------|------|
| Plans/<br>Models                      | Product plans                             | Sales territory<br>Market plans | Facility plans<br>Capacity plans         | Material requirements<br>Production schedule |      |
| Statistical/<br>Summary               | Product demand                            | Sales history                   | Work in process<br>Equipment utilization | Open requirements                            |      |
| Inventory                             | Product<br>Finished goods<br>Parts master | Customer                        | Facilities<br>Machine load<br>Re         | Raw Material                                 |      |
| Transaction                           | Order                                     | Shipment                        |                                          |                                              |      |

In any case, the key to data classification lies in abiding by the criteria, and given that qualification, the BICS approach meets the criteria by definition. The BSP approach may meet the criteria depending upon the skills and understanding of the analysts.

In Difference D, BSP uses two levels of differentiation of responsibility concerning the data classes, whereas BICS uses four levels of differentiation. Because BSP attempts to expose the issue of data integrity analytically, it must prove that there are single sources for the various data classes and also that there is a requirement for parallel distribution of the data to multiple users. Therefore, BSP specifies which business processes serve as the single source of each data class as differentiated from those processes that merely use the data. The single source is called the "create" point and means that a specific business process is processing the events (or transactions) that originate the data or insert it into the business system as a whole. Processes that merely use the data after it has been acquired by the business are called "usage" points. The "create" and "usage" points imply a natural sequencing for development or implementation which is required if the business is to manage data integrity through controlling the data at its source.

Because BICS focuses upon the data/organization relationship, the issues of authority and accountability are also introduced and added to the concept of create versus use. Different organizations are held accountable for different aspects of the same data. One organization

**data  
responsibilities**

may be responsible for defining the data, a different organization for the content of the data base, a third for authorizing access to the data, and others for using the data. Therefore, BICS uses four levels of differentiation because of its use of organization as a component of its primary structure. The relationships between the BSP and BICS levels are shown in Table 2.

BSP does not need the two additional levels of differentiation because it does not develop the data/organization relationship. That is, authority or accountability is assigned to people (organization), not to process (function). However, BSP's "Create" is roughly equivalent to "Data Content" and "Use" to "Data Usage."

#### **derivation of structure**

Difference E relates to the manner in which BSP and BICS derive the structures such that they are uniquely tailored to the business unit under study.

In BSP, each structure for each business is uniquely created by the study team such that it describes the business to their own satisfaction. The BSP structure is created from scratch every time and is expressly tailored to fit the business. Its validity is quite dependent upon the skills and understanding of the study team. However, as a result, the BSP structure is very flexible and can describe any business to anyone's satisfaction.

**Table 2** Relationships between BSP and BICS levels

|    | <i>BSP</i> | <i>BICS</i>     |
|----|------------|-----------------|
| 1. | Create     | Data content    |
| 2. | Use        | Data usage      |
| 3. | —          | Data definition |
| 4. | —          | Data access     |

In BICS, the structure is extracted from a superset of predefined categories and relationships which are contained in a generalized model. Those categories and relationships that are pertinent to a specific business are assembled to represent the business under study. Since the BICS structure is predefined, it is quickly generated, reproducible, and somewhat less dependent upon the skills and understanding of the analysts. However, because of its predefinition, some constraints must be accepted in terms of how things are categorized and related.

#### **BSP strengths and weaknesses**

Several weaknesses can be noted in BSP. First, because BSP is a creative analysis in which the study team manually classifies, defines, relates, analyzes, concludes, etc., its quality is very dependent upon the team's understanding of what they are looking for and their ability to find it. Second, because the structure developed is created from scratch, it is highly customized to the business studied and therefore has little transferability to or comparability with other study structures. Third, it is very difficult to bridge between the planning activity of the study and the implementation. No design falls out of the BSP analysis, and implementations must revert to classic application development techniques. In short, no magic and no design and development shortcuts are inherent in BSP.

Nonetheless, BSP strengths are considerable. It is a very good, structured approach to deal with a very complex problem. Properly applied, it effectively exposes the data issue fully and confronts management with the fact that decisions of the data processing organization are clearly trade-offs between long-term options and short-term options. It helps establish communications among data processing, the user community, and top management. It develops an enterprise-level architecture (albeit rather rudimentary) and objectively deals with the priority issue, identifying areas in which the information system resource can best be invested for the overall interest of the business at a given point in time.

BSP's greatest strength lies in the fact that it is well-documented, supported by IBM education, widely used, well-understood, and available *now*. Actually, in 1981, as far as the general customer environment is concerned, it is almost "the only game in town." As a matter of fact, many of the consulting firms that offer information systems planning-type services explicitly sell BSP or a BSP derivative as a product. (This statement is not meant to exclude or minimize other I/S planning methodologies such as those referred to in the introduction of this paper. Rather, it is meant to emphasize the widespread use of BSP as a tool for *enterprise analysis*.)

In the future, the documentation aspects of BSP could easily be automated, making the process considerably easier. A BSP model has already been described for the Information Management System (IMS) Data Dictionary using the extensibility features.<sup>17</sup> Study teams are beginning to use the Dictionary as a repository for the BSP data. Furthermore, BSP is an excellent study methodology that could be adapted relatively easily for use with other analytical tools. (For example, other analytical tools might include BIAIT,<sup>11</sup> PSL/PSA,<sup>8</sup> SADT,<sup>10</sup> etc.)

### **BICS strengths and weaknesses**

BICS has several weaknesses to be considered. First, BICS is not supported with an adequate theoretical foundation. The BIAIT theory,<sup>11</sup> though apparently on the right track, needs quite a bit more research and development before it can be considered something of a science. The structures and classifications are based on empirical evidence rather than theoretical foundation. It is only fair to say that this is no more the case for BICS than for BSP; however, BSP does not produce predefined structures that connote theoretical substantiation as does BICS.

Second, although BICS has some good empirical validation, it is by no means extensive at this time. Its use has been largely limited to IBM internal business units, although they have been quite diverse in nature and have therefore served as reasonable test cases.

Third, there is some inflexibility inherent in the BICS model because it is predefined. This inflexibility means that in order to use it, a study team may have to "force-fit" some of the structure.

Fourth, at the present time, BICS is not well-documented, and very few people are trained in the methodology. Therefore, its availability is severely limited.

BICS does have considerable strengths. Because of its predefined structure, the tailored model of the business unit under study is generated rather than created from scratch. At worst it would have to be validated and altered, if considered necessary, to represent the business. Therefore, it is quick, it requires minimal labor, and the resultant structure is reproducible. Any analyst, regardless of skill, should come up with the same structure for the same business. Furthermore, BICS leads to quick solutions, relieving current management frustrations even though the longer-term fixes are deferred until the environment is stabilized.

The greatest strength of BICS lies in its future potential. Given sufficient time, good theoretical substantiation could develop. Even if the theory did not evolve, sufficient empirical evidence would give substantial credence to and/or confidence in the model to make it a valuable tool. Also, additional time will allow other classes of things pertaining to the business to be predefined and added into the data classes in the current model. Other classes of things which would be of interest would be processes (which is nearly complete), objectives, measurements, reports and forms, job classifications, critical success factors, etc. As these additional pieces of work are completed, the resultant structure begins to look like an holistic model of the business which could be used for business planning purposes, not merely information planning purposes.

Further along, since BICS is dealing with predefined classes of things, it is reasonable to suspect that the specific content of the classes could also be predefined. Then, with predefined, specific data entities and attributes, processes (function), objectives, etc., along with predefined relationships between the elements of the model, it is reasonable to suspect that BICS could produce predefined data design and predefined functional code. Therefore, with a limited set of variables describing the business, a structure (or model) could be quickly generated with minimal labor. From the structure, predefined systems design could be generated (both function and data), thus establishing a solid bridge between the planning activity and the implementation. Even if this goal is not practical in the reasonably near future, the preponderant demand for increased productivity in application development makes this BICS potential an exciting consideration.

## Conclusions

The area of enterprise analysis is in its formative stages. As the technology continues to mature and as industry evolves to later stages of learning with regard to managing data,<sup>18</sup> the demand for greater levels of sophistication in enterprise analysis will increase. Enterprise-level dependencies will have to be identified and protected to provide for systems and data integration. Limited information systems resources will have to be effectively allocated. Short-term and long-term trade-offs will have to be made in determining the information system resource investment strategies. Holistic models of the business will be required to support the management planning and control apparatus. These issues will become more pressing over time and will precipitate substantial increases in the body of knowledge concerning enterprise analysis.

It is likely that a science will evolve which will enable the description of the generic structure of a business. With such a science, theoretical definitions could be established for such items as business processes, data classes, objectives, measurements, critical success factors, and so on. Logical boundaries and interfaces or relationships between the various elements of the business could be identified. Structural aspects of tools like BSP and BICS, which are now dependent upon empirical observations, could be theoretically substantiated. With good, theoretically substantiated structures, it would be possible to move with confidence into the realm of automatic code generation and automated data design. These procedures open the door to very sophisticated study methodologies which, in practice, could automatically generate information systems from a very few variables describing the business. It would truly open the door to managing data as a resource.

Business Modeling Technology<sup>19</sup> potentially is the beginning of such a science. The ultimate implications of theoretical frameworks such as Business Modeling Technology reach far beyond merely automating systems design or managing data. They reach into the realms of strategic business planning and management science in general. The business environment of the 1980s likely will contain very strong forces which will demand investment in such science-like research and development projects.

With regard to BSP and BICS, although the future may reveal that they are rather primitive, in the present they are substantive representations of enterprise analysis-oriented planning tools. Their considerable similarity makes them mutually exclusive. That is, a choice has to be made as to which is more appropriate in a given situation. The single difference that is most likely to influence the choice is the difference in study strategy. If the study is intended to get the data issue out in the open and force an overt change in the design approach to information systems, then BSP is the most

appropriate choice. If the study strategy is intended to relieve some current management frustrations with specific, data-oriented solutions, then BICS is the most appropriate choice.

The current limited availability, limited depth of empirical validation, and affinity for relational data base implementations of BICS are the tempering factors for selecting BICS at present. Time will mitigate some of these limitations as it will also amplify the strengths of BICS in rapid generation of predefined structures and reproducibility. Ultimately, with continued research and development, the BICS potential of drawing closer to requirements definition and design specification is likely to become very attractive.

Either of these study methodologies may be employed by study teams that are completely oblivious to the more esoteric issues of enterprise architectures, to data-driven systems design, to long-term and short-term investment strategies, to serial versus parallel distribution of data, to data classification criteria, and so on. In this case, it does not really matter which methodology is employed. In fact, many studies have been done by merely following the methodology as a "cook book." By doing so, substantial success may even be achieved, but the results are usually limited to identifying a set of applications projects to work on, establishing increased management involvement in data processing planning, and facilitating communications with the users. Unfortunately, these studies do not get at the heart of management's frustration with the current application portfolio which centers around the data problem and these more complex issues. It then takes a second (or third, or fourth, etc.) iteration. Each iteration considerably increases the learning process of the business with regard to managing its data. Therefore, every iteration is valuable, independent of the methodology; however, the methodology becomes more important as the level of learning increases.

The issues that have to be learned are complex, and the learning can be long and arduous. BSP and BICS (and other enterprise analysis techniques) are catalysts to the learning process as much as they are short cuts. They precipitate learning as well as providing well-thought-through analyses based upon a substantial body of knowledge.

Every business that continues to grow and evolve is likely to have to employ some form of enterprise analysis. BSP and BICS are important representatives of what is available today.

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